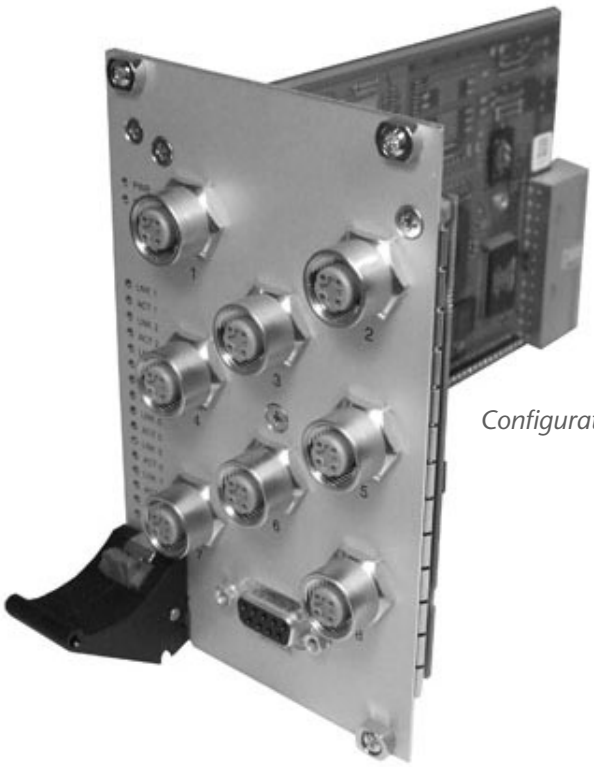
Embedded Solutions

F302 – 3U CompactPCI®
Industrial Ethernet Switch



Configuration example

User Manual

mikro elektronik
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F302 – 3U CompactPCI® Industrial Ethernet Switch

The F302 is a managed 3U Fast Ethernet switch module with a maximum of eight channels at the front panel (8 RJ45 or M12 connectors) plus one additional Ethernet channel that is led to the CompactPCI® J1 connector at the rear.

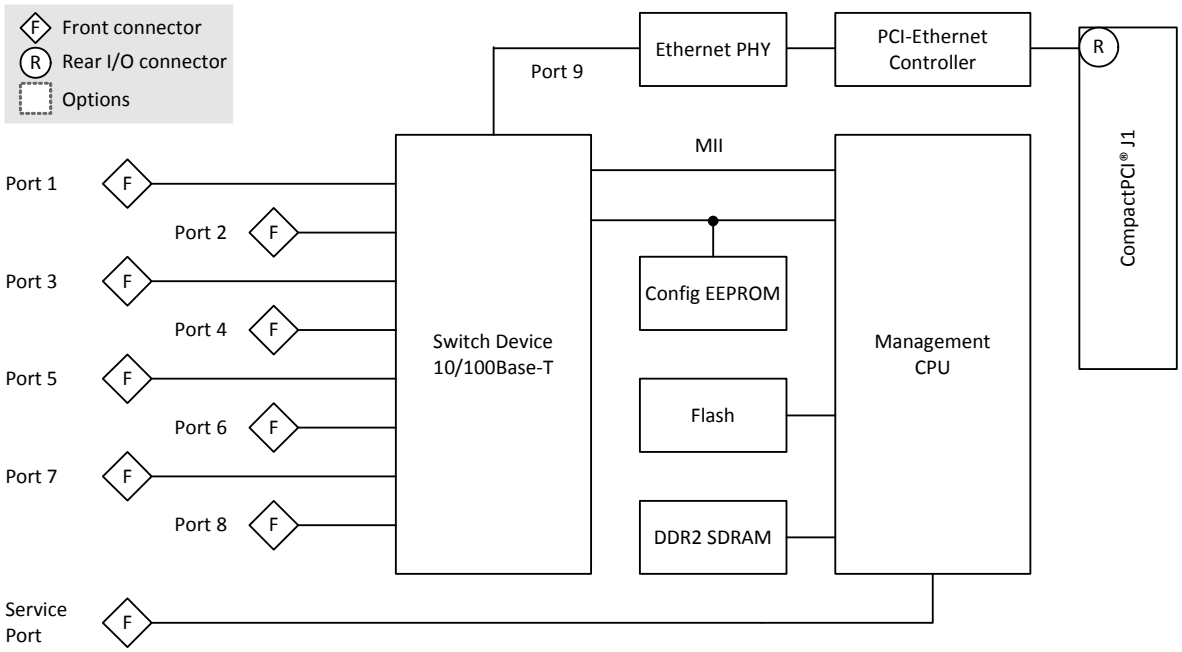
The F302 is managed by its own PowerPC® CPU that integrates the configuration firmware. A service interface is accessible at the front panel, providing an easy way to configure the switch. A command line interface is available via the RS232 at the service port and over Ethernet via Telnet or Secure Shell (SSH). The switch can also be configured via SNMP (version 3). Additionally, the service connector can be used to attach an external dongle to store or update the switch configuration. This makes it easy to exchange the unit for service purposes.

The F302 supports full-duplex and half-duplex operation with auto-negotiation, high-speed non-blocking store-and-forward-switching, Quality of Service (QoS) support with four traffic classes IEEE 802.1p and three-level 802.1x security as well as the logical segmentation of ports (802.1q VLANs). The switch is fault tolerant and restores itself on its own: If a link is temporarily unavailable, frames can be sent via backup/redundant links (spanning tree protocol / link aggregation) and no data loss occurs. Its built-in test mechanisms make the F302 an even more reliable component in the communication system.

The F302 was specifically designed for rugged mobile communication systems. It is thus for example fully compliant with the EN 50155 railway standard. All components on the board are specified for a -40 to +85°C operation temperature. There are no socketed components, hardening the card against shock and vibration. The board is ready for coating (standard with M12 connectors) and has a guaranteed minimum standard availability of 5 years.

Depending on the connector type, the F302 has a front-panel width of 12 HP (3 slots) with RJ45 or 16 HP (4 slots) with M12 connectors. In either case the card occupies only one CompactPCI® backplane slot.

Diagram


Front connector
Rear I/O connector
Options
Port 9
Ethernet PHY
PCI-Ethernet Controller
R
CompactPCI® J1
MII
Port 1
Port 2
Port 3
Port 4
Port 5
Port 6
Port 7
Port 8
F
Switch Device 10/100Base-T
Config EEPROM
Flash
DDR2 SDRAM
Management CPU
Service Port

Technical Data

Key Features

- Simple Switch replacement: configuration can be done via external dongle without any tools
- High-speed non-blocking, store-and-forward switching
- Up to eight 10/100Base-T ports at front panel (Electrical isolation: 1500 Vrms)
- One 10/100Base-T port at rear connector
- Port configuration: copper, 10/100 Mbit/s
- Auto-negotiation / Auto MDI/MDIX crossover on all ports / manual configuration possible
- Layer2-based Policy Control List
- 8K MAC address lookup table with automatic learning and aging
- Up to 4096 VLANs
- Rapid Spanning Tree Protocol and Multiple Spanning Tree Protocol to ensure loop free topology formation
- Reducing multicast traffic in the network through multicast snooping – IGS (IPv4) and MLDS (IPv6)

Management Firmware System Features

- Saving and restoring user configurations
- Software upgrades through TFTP
- System logs (syslog) and e-mail alerts for critical events
- Remote monitoring (RMON) and alarm generation
- Displaying the running configuration in the form of CLI commands
- Management interfaces through
  - CLI (RS232 console, Telnet, SSH)
  - SNMP v3
- Switch configuration can be loaded from external dongle

Management Firmware Security Features

- User authentication using IEEE 802.1x
- Controlling management access through SNMP and CLI only from authorized managers
- MAC based access list (ACL) for traffic filtering
- Rate-limiting and storm control to prevent packet flooding from malicious peers

Supported Protocols and Standards

- DHCP client / server / relay (IEEE 1394)
- GVRP/GMRP support (IEEE 802.1D, 2004)
- Hypertext Transport Protocol (HTTP) Server for Remote Management and Monitoring (RFC2626)
- HTTP Secure (HTTPS) – HTTP-based Remote Management over encrypted data channel (RFC2818)
- IGMP snooping / IGMP proxy / IGMP Querier / MLD Discovery (RFC 4541)
- Link aggregation LACP / EtherChannel (IEEE 802.3ad, 2005)

- Link Layer Discovery Protocol LLDP (IEEE 802.1ab, 2005)
- Multiple Spanning Tree (MSTP) (IEEE 802.1s)
- Priority-based switching, Quality of Service/DiffServ, tagged frames, Layer2-based 801.1Q VLAN-ID packet routing (IEEE 802.1p)
- Port-based authentication with EAP (IEEE 802.1x – REV2004/RFC3748)
- Rapid Spanning Tree Protocol (RSTP IEEE 802.1w)
- Secure Shell (SSH) for Remote Configuration (CLI) over secure channel
- SNMP v1, v2c, v3 management
- Syslog (RFC 5424)
- TCP/IP v4 and v6
- TFTP (RFC 1350)
- VLAN/port-based VLANs GVRP/MVRP (IEEE 802.1Q Rev D5.0, 2005)

Service Interface

- 9-pin D-Sub connector at front
- RS232 / V24
- I2C interface for external dongle

Front I/O

- Eight Ethernet ports on RJ45 or M12 connectors
- One service interface via 9-pin D-Sub connector
- 16 link and activity Ethernet status LEDs (2 per channel)
- Status LEDs for power, reset and error codes

Rear I/O

- One 10/100Base-T port via CompactPCI® J1 (rear)

CompactPCI® Bus

- Compliance with CompactPCI® Specification 2.0 R3.0
- Only one slot required on the 3U CompactPCI® bus
- Peripheral slot
- Compliance with PCI Specification 2.1
- V(I/O): +3.3 V
- Ninth Fast Ethernet port via CompactPCI® J1

Electrical Specifications

- Supply voltage/power consumption:
  - +3.3 V (-3%/+5%), 5 W
  - +5 V (-3%/+5%), 5 W

Mechanical Specifications

- Dimensions: conforming to CompactPCI® specification for 3U boards
- Weight: 316 g (16HP model with M12 connectors)

Environmental Specifications

- Temperature range (operation):
  - -40..+85°C (qualified components)
  - Airflow: min. 10 m³/h
- Temperature range (storage): -40..+85°C
- Relative humidity (operation): max. 95% non-condensing
- Relative humidity (storage): max. 95% non-condensing
- Altitude: -300 m to + 3000 m
- Shock: according to EN 60068-2-27
- Bump: according to EN 60068-2-29
- Vibration (sinusoidal): according to EN 60068-2-6
- Conformal coating on request (standard with M12 connectors)

MTBF

- 778 505 h (RJ45 model) or 752 506 h (M12 model) @ 40°C according to IEC/TR 62380 (RDF 2000)

Safety

- Flammability
  - PCB manufactured with a flammability rating of 94V-0 by UL recognized manufacturers

EMC Conformity

- EN 55022 (radio disturbance)
- EN61000-4-2 (ESD Immunity)
- IEC 61000-4-4 (burst)

Software Support

- Firmware for configuration and management included
- For more information on supported operating system versions and drivers see online data sheet.

Configuration Options

Front Connectors / Mechanical

- RJ45 connectors
  - 12 HP (3-slot) front panel
- M12 D connectors
  - 16 HP (4-slot) front panel

Environmental specifications

- Conformal coating for RJ45 models (standard with M12 connectors)

Cooling Concept

- Also available with conduction cooling in MEN CCA frame

Please note that some of these options may only be available for large volumes. Please ask our sales staff for more information.

For available standard configurations see online data sheet.

Product Safety

Electrostatic Discharge (ESD)

Computer boards and components contain electrostatic sensitive devices. Electrostatic discharge (ESD) can damage components. To protect the board and other components against damage from static electricity, you should follow some precautions whenever you work on your computer.

- Power down and unplug your computer system when working on the inside.
- Hold components by the edges and try not to touch the IC chips, leads, or circuitry.
- Use a grounded wrist strap before handling computer components.
- Place components on a grounded antistatic pad or on the bag that came with the component whenever the components are separated from the system.
- Store the board only in its original ESD-protected packaging. Retain the original packaging in case you need to return the board to MEN for repair.

About this Document

This user manual is intended only for system developers and integrators, it is not intended for end users.

It describes the hardware functions of the board, connection of peripheral devices and integration into a system. It also provides additional information for special applications and configurations of the board.

The manual does not include detailed information on individual components (data sheets etc.). A list of literature is given in the appendix.

History

Issue	Comments	Date
E1	First issue	2009-02-16
E2	Major general update based on new hardware and firmware specification	2010-02-15
E3	Unit also supports +5 V supply voltage, added power consumption Reworked block diagram (connection between CPU and switch device, config EEPROM connection) Removed IP-based ACL from technical data Moved TCP/IP (IPv4, IPv6) to Layer 2 features	2010-12-15
E4	Slight changes to clarify support of +5 V supply voltage	2010-12-16
E5	V(I/O): Board supports only 3.3 V	2011-07-21
E6	Added Figure 2, Board map of standard version with RJ45 connectors, on page 16 Added note in Chapter 2.3 Service Interface (RS232 / I2C) on page 19	2012-08-16
E7	Clarified details on ninth Ethernet port; deleted configuration via web server interface	2013-07-10

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This sign marks important notes or warnings concerning the use of voltages which can lead to serious damage to your health and also cause damage or destruction of the component.

This sign marks important notes or warnings concerning proper functionality of the product described in this document. You should read them in any case.

italics — Folder, file and function names are printed in *italics*.

bold — **Bold** type is used for emphasis.

`monospace` — A `monospaced` font type is used for hexadecimal numbers, listings, C function descriptions or wherever appropriate. Hexadecimal numbers are preceded by "0x".

comment — Comments embedded into coding examples are shown in green color.

hyperlink — Hyperlinks are printed in blue color.

The globe will show you where hyperlinks lead directly to the Internet, so you can look for the latest information online.

IRQ# /IRQ — Signal names followed by "#" or preceded by a slash ("/") indicate that this signal is either active low or that it becomes active at a falling edge.

in/out — Signal directions in signal mnemonics tables generally refer to the corresponding board or component, "in" meaning "to the board or component", "out" meaning "coming from it".

Vertical lines on the outer margin signal technical changes to the previous issue of the document.

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Since January 2005 the SMD and manual soldering processes at MEN have already been completely lead-free. Between June 2004 and June 30, 2006 MEN's selected component suppliers have changed delivery to RoHS-compliant parts. During this period any change and status was traceable through the MEN ERP system and the boards gradually became RoHS-compliant.

WEEE Application

The WEEE directive does not apply to fixed industrial plants and tools. The compliance is the responsibility of the company which puts the product on the market, as defined in the directive; components and sub-assemblies are not subject to product compliance.

In other words: Since MEN does not deliver ready-made products to end users, the WEEE directive is not applicable for MEN. Users are nevertheless recommended to properly recycle all electronic boards which have passed their life cycle.

Nevertheless, MEN is registered as a manufacturer in Germany. The registration number can be provided on request.

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Contents

1 Getting Started 15
1.1 Front Panels 15
1.2 Integrating the Board into a System 16
1.3 Installing Driver Software 16
2 Functional Description 17
2.1 Power Supply 17
2.2 Ethernet Interface 17
2.2.1 Ethernet Switch 18
2.2.2 Configuration of the Switch 19
2.3 Service Interface (RS232 / I2C) 20
2.4 Front Panel Status LEDs 21
2.4.1 General Status LEDs 21
2.4.2 Service LEDs 21
2.4.3 Ethernet Port Status LEDs 22
2.5 CompactPCI Interface 23
3 Appendix 24
3.1 Literature and Web Resources 24
3.2 Finding out the Board's Article Number, Revision and Serial Number 24

Figures

Figure 1. Front panels – with RJ45 connectors (left) or M12 connectors (right) 15
Figure 2. Board map of standard version with RJ45 connectors 16
Figure 3. Labels giving the board's article number, revision and serial number 24

Tables

Table 1. Signal mnemonics of Ethernet 10/100Base-T connectors 17
Table 2. Pin assignment of 8-pin RJ45 Ethernet 10/100Base-T connectors . . . 17
Table 3. Pin assignment of 4-pin M12 Ethernet 10/100Base-T connectors 17
Table 4. Default switch configuration at startup 19
Table 5. Pin assignment of 9-pin D-Sub service interface connector. 20
Table 6. Signal mnemonics of 9-pin D-Sub service interface connector 20
Table 7. Front-panel status LEDs 21
Table 8. General status LEDs 21
Table 9. Service LEDs 21
Table 10. Error codes signaled via service LEDs. 22
Table 11. Ethernet port status LEDs. 22

1 Getting Started

This chapter gives an overview of the board and some hints for first installation in a system.

1.1 Front Panels

Two different types of front panels are available for the F302:

- 8 RJ45 connectors on a 12HP front panel (standard)
- 8 M12 connectors on a 16HP front panel (optional)

Figure 1. *Front panels – with RJ45 connectors (left) or M12 connectors (right)*

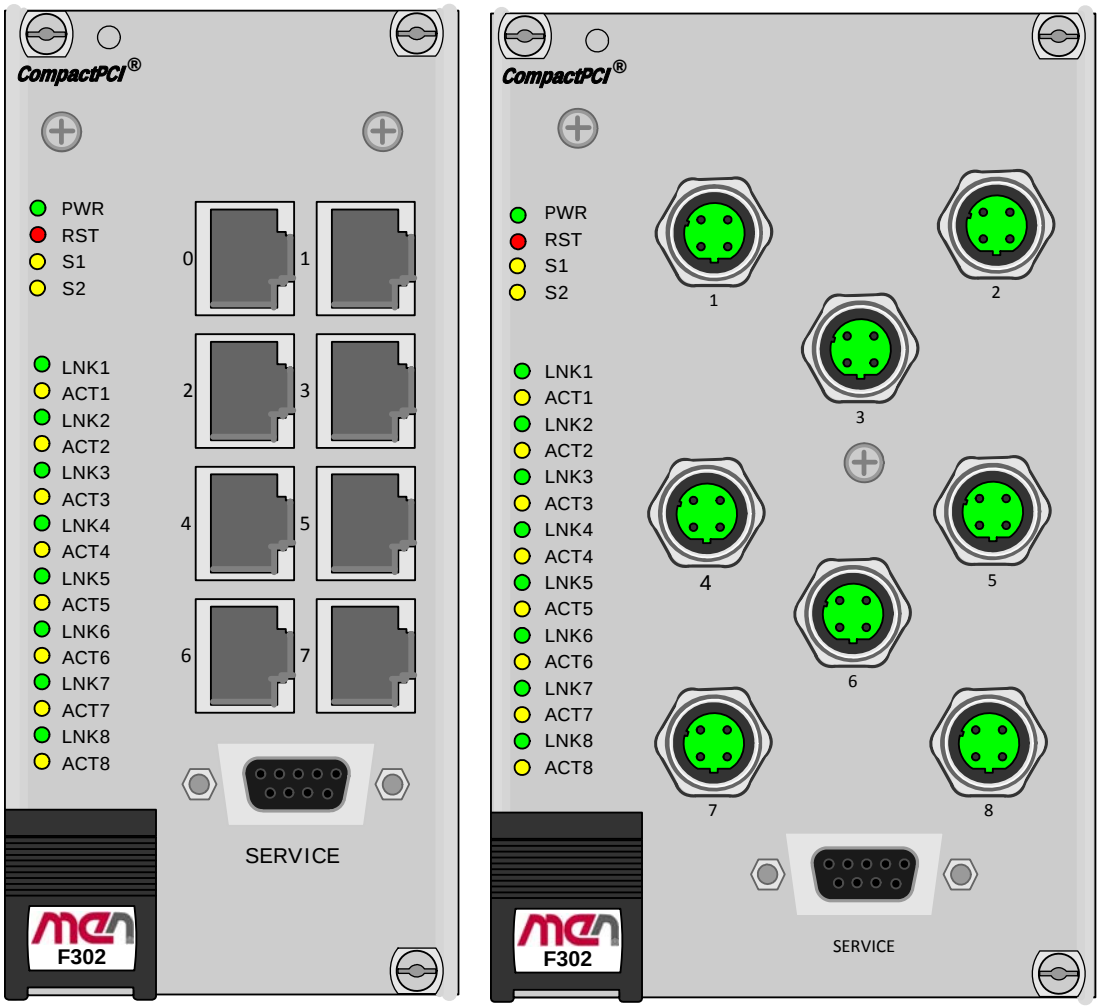
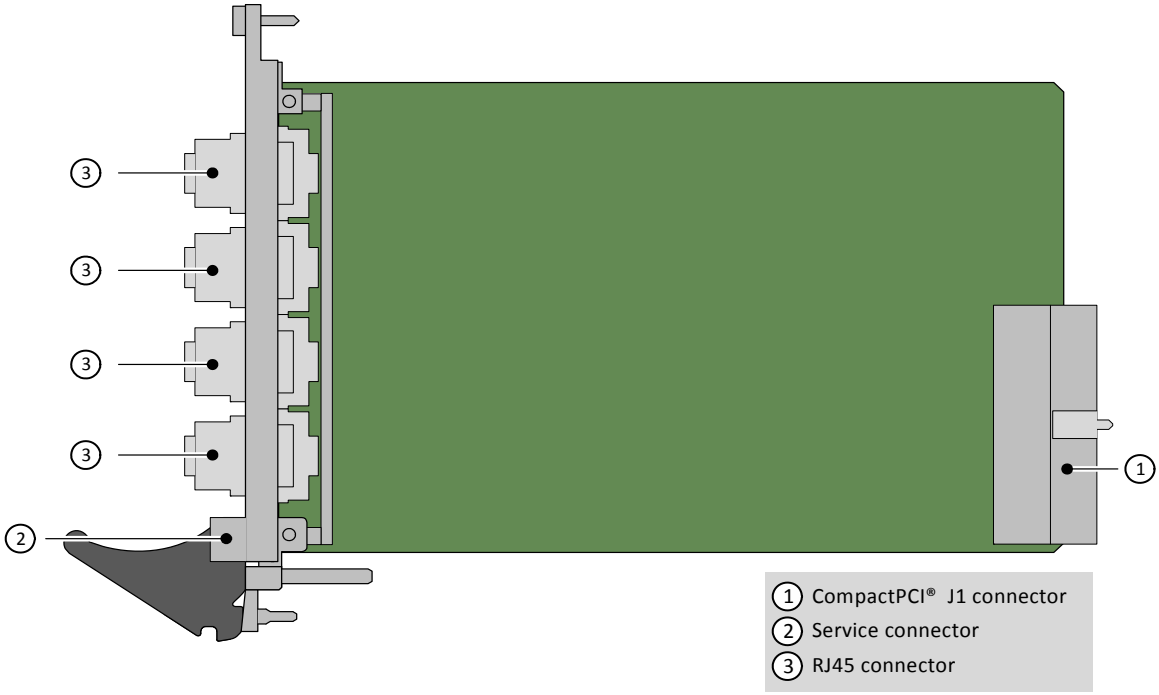


Figure 2. *Board map of standard version with RJ45 connectors*



1.2 Integrating the Board into a System

You can use the following "check list" when installing the F302 in a CompactPCI system for the first time.

- ☑ Power-down the system.
- ☑ Insert the F302 into a peripheral slot of your CompactPCI system, making sure that the CompactPCI connectors are properly aligned.

  Note: The peripheral slots of every CompactPCI system are marked by a circle ○ on the backplane and/or at the front panel.
- ☑ Power-up the system.
- ☑ You can now install driver software for the F302 Ethernet controllers, if needed.

1.3 Installing Driver Software

For a detailed description on how to install driver software please refer to the respective documentation.

You can find any driver software available for download on the F302 pages on MEN's website.

2 Functional Description

2.1 Power Supply

The F302 is supplied with +3.3 V or +5 V via the CompactPCI bus.

2.2 Ethernet Interface

The F302 offers eight Ethernet ports at the front. An additional Ethernet port is accessible via the CompactPCI bus on the connected host computer (see Chapter 2.5 CompactPCI Interface on page 23).

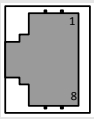
Table 1. *Signal mnemonics of Ethernet 10/100Base-T connectors*

Signal	Direction	Function
RX+/-	in	Differential pair of receive data lines for 10/100Base-T
TX+/-	out	Differential pair of transmit data lines for 10/100Base-T

Connector types for the RJ45 version:

- Modular 8/8-pin mounting jack according to FCC68
- Mating connector:
  Modular 8/8-pin plug according to FCC68

Table 2. *Pin assignment of 8-pin RJ45 Ethernet 10/100Base-T connectors*

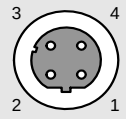


1	RX+
2	RX-
3	TX+
4	-
5	-
6	TX-
7	-
8	-

Connector types for the M12 version:

- 4-pin circular M12 receptacle
- Mating connector: 4-pin circular M12 plug

Table 3. *Pin assignment of 4-pin M12 Ethernet 10/100Base-T connectors*



1	TX+
2	RX+
3	TX-
4	RX-

The management interface and the Ethernet ports have their own MAC address etc.

The unique MAC addresses are set at the factory and should not be changed. Any attempt to change these addresses may create node or bus contention and thereby render the switch inoperable. The MAC addresses on the F302 are:

- Management interface: 0x 00 C0 3A 9F xx x0
- Port 1: 0x 00 C0 3A 9F xx x1
- Port 2: 0x 00 C0 3A 9F xx x2
- ...
- Port 8: 0x 00 C0 3A 9F xx x8
- Port 9 (Gigabit Uplink): 0x 00 C0 3A 9F xx x9

where "00 C0 3A" is the MEN vendor code, "9F" is the MEN product codes, and "xx x" is the hexadecimal serial number of the product, which depends on your switch, e.g., "... 02 A3" for serial number "000042" (0x2A) and port 3. (See Chapter 3.2 Finding out the Board's Article Number, Revision and Serial Number on page 24.)

2.2.1 Ethernet Switch

The F302 uses a manageable 8-port 10/100Base-T switch component, the Marvell 88E6095. The switch provides 10/100 Mbits/s configuration possibility on each of the eight external ports.

It is also possible to configure each port in half-duplex or full-duplex.

The device characteristics are:

- 8 external ports configurable as 10/100 Mbits/s
- 1 internal 100Base-T port accessible at the CompactPCI connector J1
- MII interface
- Each external port is configurable in half-duplex or full-duplex mode
- Non-blocking wire speed switching
- Store-and-forward mode
- Auto negotiation
- Port mirroring
- Port monitoring
- Flow control
- VLAN support
- Automatic MDI/MDI-X crossover (all ports)
- Port based frame priorization

2.2.2 Configuration of the Switch

The F302 loads the following standard configuration for the 8 ports available at the front of the unit at startup:

Table 4. *Default switch configuration at startup*

Setting	Default
Duplex mode	Full Duplex
Port speed	Auto-Negotiate
VLAN (port-based)	Off
QoS (Quality of Service)	Off
Port mirroring and port monitoring	Off
Port trunking	Off

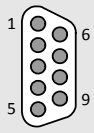
All of the ports are individually configurable using an external dongle, a Telnet or Secure Shell (SSH) command line interface via the D-Sub service connector or over Ethernet via SNMP (Version 3). For further information about configuration options please refer to the documentation of the F302 firmware.

2.3 Service Interface (RS232 / I2C)

The service connector features an RS232 UART interface for maintenance purposes. Further information about maintenance and configuration options is provided in the documentation of the F302 firmware.

An I2C connection is also available to connect an external dongle (available from MEN) for easy dumping or uploading of configuration data.

Table 5. *Pin assignment of 9-pin D-Sub service interface connector*



1	GPIO[0]
2	RS232_RX
3	RS232_TX
4	SCL
5	GND
6	GPIO[1]
7	+3.3V
8	SDA
9	GND

Table 6. *Signal mnemonics of 9-pin D-Sub service interface connector*

Signal	Direction	Function
GPIO[0]	in/out	General purpose I/O 0 Apply active signal for more than 2 seconds: Reset Apply active signal for more than 10 seconds: Reset with restored factory settings
GPIO[1]	in/out	General purpose I/O 1 Used for detection of external dongle
RS232_RX	in	RS232 receive data
RS232_TX	out	RS232 transmit data
SDA	in/out	I2C serial data input/output for external dongle
SCL		I2C data clock for external dongle
+3.3V	out	Power supply for external dongle
GND		Ground

Note: Do not use a standard Nullmodem cable as it blocks the I2C bus and prevents the switch from a correct booting.

2.4 Front Panel Status LEDs

The F302 has a number of status LEDs at its front panel.

Table 7. *Front-panel status LEDs*

LED	Description
PWR	General Power Good
RST	Reset
S1	Service LED 1
S2	Service LED 2
LNK 1	Port 1 link/data receive
ACT 1	Port 1 link/data receive
LNK 2	Port 2 link/data receive
ACT 2	Port 2 link/data receive
...	...
LNK 8	Port 8 link/data receive
ACT 8	Port 8 link/data receive

2.4.1 General Status LEDs

Table 8. *General status LEDs*

LED	Description
PWR	On: Switch is powered on
RST	On: Reset signal is active

2.4.2 Service LEDs

Table 9. *Service LEDs*

LED	Description
S1	Micro controller LED (function depends on software)
S2	Micro controller LED (function depends on software)

The micro controller uses the LEDs connected to it to indicate the reason for an error during startup. The status LED will blink or light up as listed in Table 10, Error codes signaled via service LEDs until the system is restarted or completely powered off. The supported error codes are as follows:

Table 10. *Error codes signaled via service LEDs*

Failure source	S1	S2
RS232 UART	fast	fast
Memory	fast	slow
Marvell switch access	slow	fast
Marvell switch internal PHYs	slow	on
External PHYs	slow	slow
Temperature sensor	on	fast
IDPROM	on	on
PoE	on	slow
Firmware image	off	on
Unspecified	off	fast

"Slow" means blinking with a frequency of 1 Hz, "fast" means blinking with a frequency of 10 Hz.

2.4.3 Ethernet Port Status LEDs

Each Ethernet user port (1 to 8) provides two LEDs to display its status (*LNK x* and *ACT x*). The display LEDs act as described in the following table.

Table 11. *Ethernet port status LEDs*

LED	Description
LNK x	On: Link up
ACT x	On: Transmit or receive activity

An alternative LED configuration with one LED indicating link status and receive activity and the other indicating transmit activity can be realized on demand.

2.5 CompactPCI Interface

The F302 supports a 32-bit 33-MHz CompactPCI interface fully compatible with CompactPCI specification PICMG 2.0 Rev. 3.0. The board works with 3.3V for V(I/O) only. For full CompactPCI functionality only the J1 connector is needed, therefore the board only has a J1 connector to the bus.

An internal Ethernet controller connects the CompactPCI bus to the ninth Ethernet port. Therefore, the ninth Ethernet port is accessible on the connected host computer.

Connector type of J1:

- 110-pin shielded, 2mm-pitch, 5-row receptacle according to IEC 917 and IEC 1076-4-101

The pin assignment of connector J1 as defined in the CompactPCI specification will not be repeated here.

3 Appendix

3.1 Literature and Web Resources

- F302 data sheet with up-to-date information and documentation: http://www.men.de/products/02F302-.html

3.2 Finding out the Board's Article Number, Revision and Serial Number

MEN user documentation may describe several different models and/or hardware revisions of the F302. You can find information on the article number, the board revision and the serial number on two labels attached to the board.

- **Article number:** Gives the board's family and model. This is also MEN's ordering number. To be complete it must have 9 characters.
- **Revision number:** Gives the hardware revision of the board.
- **Serial number:** Unique identification assigned during production.

If you need support, you should communicate these numbers to MEN.

Figure 3. *Labels giving the board's article number, revision and serial number*